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Plant Closure in Britain since the Great Recession

Richard Harris^a & John Moffat^b

^a Durham University Business School, Mill Hill Lane, Durham, DH1 3LB
E-mail: r.i.d.harris@durham.ac.uk

^b Corresponding author
Durham University Business School, Mill Hill Lane, Durham, DH1 3LB
E-mail: john.moffat@durham.ac.uk; Tel.: +44(0)191-334-5501

Abstract

One of the suggested explanations for the UK productivity puzzle is that, since the onset of the Great Recession, low productivity plants that would normally have closed have continued operating. This paper therefore investigates whether there has been a change in the relationship between productivity and closure since the recession. We find that, for a number of sectors, the negative association between TFP and closure that existed prior to the recession has been offset, or even reversed, since the recession.

JEL Codes: D22; D24; L2

Key words: Plant closure; Great Recession; Productivity

Highlights

- This paper investigates plant closure in the UK since the Great Recession
- There has been an exogenous fall in plant closure probability since 2008
- Prior to 2008, TFP was negatively related to closure in almost all sectors
- Since 2008, this association has been weakened or offset entirely in some sectors

1. Introduction

Output-per-worker in the United Kingdom (UK) remained below its 2007 level until 2014 and was, in the second quarter of 2015, over 11 per cent lower than if the pre-2008 trend had continued (ONS, 2015). This performance is unusual in the context of UK economic history since output-per-worker quickly recovered following earlier recessions (see Figure 4 in Pessoa and Van Reenen, 2014). Given the importance of productivity to long-run growth, it is unsurprising that this has been the subject of research, such that various explanations have now been put forward for the UK's productivity puzzle (e.g. Blundell et al., 2014; Disney et al., 2013; Goodridge et al., 2013; McCafferty, 2014; Pessoa and Van Reenen, 2014; Sargent, 2013). One explanation is that the process by which resources are reallocated from low to high productivity firms, particularly through the opening (closure) of more (less) productive enterprises, has been impeded by the financial crisis (Broadbent, 2012). Such reallocations of resources have been shown to be crucial using productivity growth decompositions (Disney et al., 2003; Harris and Moffat, 2013), and to have played a role in reducing productivity growth since the recession both in the UK (Barnett et al., 2014) and the United States (Foster et al., 2014). A decrease in the rate of reallocations since the recession may be caused by reluctance on behalf of banks both to lend to new firms and to stop lending to companies already in difficulty since this would entail recognising losses on their books. The latter has supposedly led to the existence of 'zombie' firms (Caballero et al, 2008) that, in normal economic circumstances, would have closed.

In order to test this hypothesis, we use plant-level data from the Annual Business Survey (ABS, formerly the Annual Respondents' Database) to estimate Cox proportional hazard models to identify whether there has been a change in the relationship between total factor productivity (TFP) and closure since the financial crisis. The next section describes the data and econometric model. The third section describes the results and the final section concludes.

2. Data and Econometric Model

The data covers 2002-2012 (although the final year cannot be used due to the impossibility of identifying plant closures) and most variables are taken from the longitudinal micro-level ARD/ABS database which has been discussed extensively elsewhere (Harris, 2005; Robjohns, 2006). Data on R&D, from the Business Enterprise Research and Development (BERD) dataset, and on outward foreign direct investment (FDI), from the Annual Foreign Direct Investment (AFDI) survey, are merged into the ARD/ABI database.

The estimated model is:

$$h(t) = h_0(t)exp(x(t)\beta) \quad (1)$$

where $h(t)$ is the probability of closure in year t , having survived until year t , $h_0(t)$ is a non-parametric baseline hazard function that is shared by all plants and $exp(x(t)\beta)$ is a parametric function of time-varying plant characteristics. The specification of the latter is:

$$x(t)\beta = \beta_R R_t + \beta_{TFP} TFP_{it} + \beta_{R \times TFP} (R_t \times TFP_{it}) + \beta_X X_{it} \quad (2)$$

where R_t is a 'recession' dummy variable that takes the value of one from 2008 onwards; TFP_{it} is an index of TFP derived using the methodology set out in Harris and Moffat (2015)¹;

¹ Unlike in Foster et al. (2014), TFP is not detrended with respect to industry and time since detrending would mean the results provided less information on why the UK's aggregate productivity performance. For example,

and X_{it} is a vector of variables likely to determine the probability of closure (see Table 1). The hazard model is stratified on employment, the relative size of the plant in the firm and the relative size of the firm in the industry; stratification was necessary in order to satisfy the proportional hazard assumption of the Cox model.

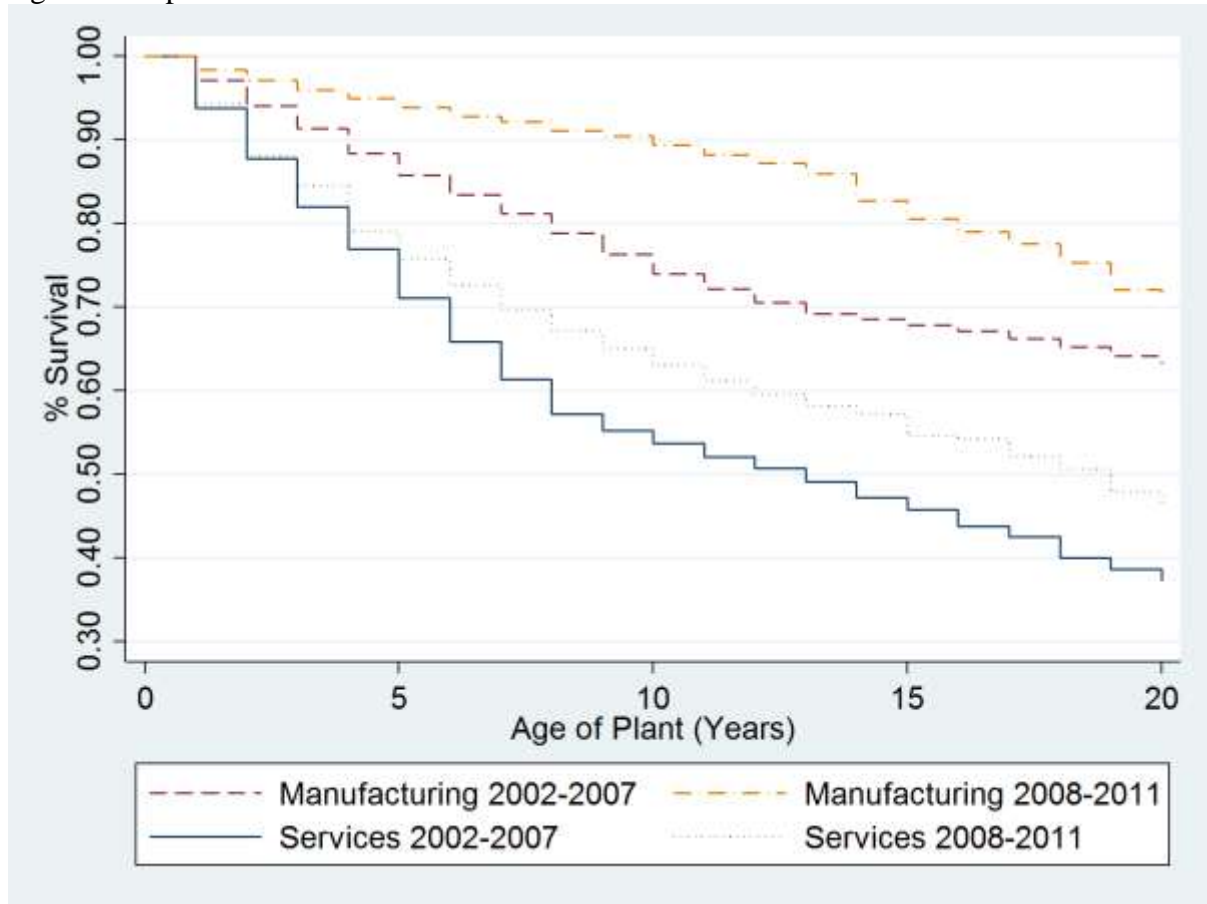
Table 1: Variables Descriptions and (weighted) mean values

| Variable | Description | Mean 2002-2007 | Mean 2008-2011 | Source |
|----------------------------|--|-------------------|-------------------|--------|
| TFP | Plant total factor productivity constructed using methods described in Harris and Moffat (2015) | 0.332 | 0.350 | ABS |
| FDI | Dummy coded 1 if plant is foreign-owned | 0.456 | 0.686 | ABS |
| Outward FDI | Dummy coded 1 if plant belongs to a UK firm involved in outward FDI | 0.160 | 0.246 | AFDI |
| R&D | Dummy coded 1 if plant belongs to a firm involved in R&D | 0.021 | 0.025 | BERD |
| City | Dummy coded 1 if plant is located in a major city | 0.230 | 0.253 | ABS |
| \ln Capital-labour ratio | Plant and machinery capital stock plus plant and machinery hires (Harris and Drinkwater, 2000, updated) divided by employment. | -5.123 | -4.964 | ABS |
| Age | Number of years plant has been in operation | 8.996 | 10.207 | ABS |
| \ln Employment | Number of employees in plant | 2.390 | 2.289 | ABS |
| Relative plant size | Employment of plant divided by employment of firm | 0.301 | 0.229 | ABS |
| Relative employment size | Employment of firm divided by employment of industry | 0.032 | 0.040 | ABS |
| Region | Dummies coded 1 if plant is located in one of 11 government office regions | n/a | n/a | ABS |

The statistical significance of $\beta_{R \times TFP}$ will show whether there has been a change in the relationship between TFP and closure since the recession and therefore whether changes in the determinants of closure have had an effect on aggregate TFP. The model is estimated for 12 sectors to allow for different relationships between the explanatory variables and closure across sectors (Table U.1 in the online appendix sets out the composition of these sectors).

if the relationship between (not detrended) TFP and closure is positive, it is clear that this would reduce aggregate TFP. By contrast, if the relationship between detrended TFP and closure is positive, that would not necessarily lower aggregate TFP since plants with high TFP (relative to the industry) may have low TFP (relative to all plants). Nevertheless, Table U.5 in the unpublished appendix shows that detrending makes little difference to the results obtained.

Figure 1: Kaplan-Meier Survival Function Estimates



3. Results

The Kaplan-Meier survival estimates in Figure 1 show that the survival probability of plants was higher in both manufacturing and services after the recession. However, such comparisons fail to take account of differences in the characteristics of plants in 2002-2007 and 2008-2011.² The results in Table 2 from estimating equation (1) show that, when these are taken into account, there has indeed been an exogenous fall in the probability of closure post-2008 in all sectors apart from retailing.

The evidence on the relationship between TFP and closure is mixed. In services, before the recession, the results show that there was a negative relationship between TFP and closure probability in all sectors before the recession. But post-2008, the relationship is mitigated or completely offset in six of the eight sectors considered (the exceptions are other low KI services and retail; the effect is not significant in sale of motor vehicles or hotels and restaurants). Thus in most service sectors, not only was there an exogenous reduction in the probability of closure ($\hat{\beta}_R < 0$), the tendency of unproductive plants to close has also diminished ($\hat{\beta}_{R \times TFP} > 0$).

² The full set of results are reported in Tables U.2-U.4 in the online appendix (<https://dl.dropboxusercontent.com/u/72592486/Online%20Appendix%20EL.pdf>); Table 2 only reports the parameter estimates for $\hat{\beta}_R$, $\hat{\beta}_{TFP}$ and $\hat{\beta}_{R \times TFP}$.

Table 2 Parameter Estimates^a of Cox proportional Hazard Model^b, 2002-2011

| | Manufacturing | | | |
|--------------------------------------|------------------------------------|----------------------|----------------------|------------------------------|
| | High-Tech | Medium High-Tech | Medium Low-Tech | Low-Tech |
| <i>ln</i> TFP | 0.246 (0.218) | -0.146 (0.156) | 0.304* (0.167) | -0.414*** (0.090) |
| <i>ln</i> TFP 2008-11 | -0.105 (0.340) | 0.397 (0.268) | 0.077 (0.284) | 1.199*** (0.188) |
| Year 2008-11 | -0.468** (0.227) | -0.681*** (0.149) | -0.753*** (0.144) | -0.933*** (0.080) |
| Observations | 4,539 | 15,107 | 22,757 | 43,109 |
| Log likelihood | -12,644 | -30,466 | -28,353 | -67,805 |
| PH test <i>p</i> -value ^c | 0.372 | 0.192 | 0.187 | 0.125 |
| | Services | | | |
| | High-Tech Knowledge Intensive (KI) | Knowledge Intensive | Low KI | Other Low KI |
| <i>ln</i> TFP | -0.493*** (0.151) | -1.846*** (0.227) | -1.135*** (0.140) | -0.835*** (0.195) |
| <i>ln</i> TFP 2008-11 | 0.991*** (0.302) | 0.830*** (0.265) | 1.082*** (0.125) | -0.781*** (0.283) |
| Year 2008-11 | -0.745*** (0.170) | -0.266** (0.119) | -0.594*** (0.081) | -0.673*** (0.069) |
| Observations | 19,795 | 34,556 | 205,350 | 102,297 |
| Log likelihood | -28,643 | -27,393 | -195,023 | -60,179 |
| PH test <i>p</i> -value | 0.633 | 0.311 | 0.164 | 0.147 |
| | | | | |
| | Sale of Motor Vehicles (SIC50) | Wholesale (SIC51) | Retail (SIC52) | Hotels & Restaurants (SIC55) |
| <i>ln</i> TFP | -0.818*** (0.213) | -0.449*** (0.098) | -1.869*** (0.140) | -3.930*** (0.369) |
| <i>ln</i> TFP 2008-11 | 1.198 (0.877) | 1.079*** (0.206) | -0.138 (0.192) | 0.534 (0.507) |
| Year 2008-11 | -0.433*** (0.047) | -1.609*** (0.072) | 0.045 (0.108) | -0.661** (0.288) |
| Observations | 64,367 | 136,546 | 492,947 | 153,776 |
| Log likelihood | -34,307 | -109,563 | -297,337 | -56,334 |
| PH test <i>p</i> -value | 0.240 | 0.068 | 0.000 | 0.723 |

Robust standard errors in parenthesis. ***/**/* denote statistical significance at the 1%/5%/10% levels

^a The full range of parameter estimates are reported in Tables U.2 – U.4 in the online appendix.

^b Stratified on age, employment, relative employment size and relative plant size.

^c Test statistic for proportional hazards assumption on the basis of Schoenfeld residuals (*phtest* in STATA)

In manufacturing, the effect of TFP on closure is not statistically significant either before or after the recession in high-tech or medium high-tech manufacturing. In low-tech manufacturing, the picture is the same as that observed in most service sectors: the negative association of TFP and closure observed prior to the recession is offset by a strong positive effect of TFP on closure after the recession. Surprisingly, in medium low-tech manufacturing, more productivity plants are more like to exit in both periods.

Since large diversified enterprises may be able to protect unproductive plants from closure,³ the model is re-estimated using two samples: the 'diversified' sample includes plants belonging to firms that are part of a larger enterprise group, foreign-owned plants and plants belonging to firms involved in outward FDI; the 'undiversified' sample includes UK-owned plants that belong to firms not owned by a larger enterprise group or involved in outward FDI. While there is little difference in the (mostly negative) relationship between TFP and closure prior to the recession across the two groups, the 'diversified group' experienced a smaller offsetting change in the relationship after the recession, particularly in services. This provides indicative evidence that the diversified group may be less dependent upon, for example, bank financing and therefore have been less affected by changes in bank behaviour since the recession.

4. Conclusion

This paper has sought to identify whether there has been a change in the probability of closure and in the relationship between TFP and closure in Britain since the Great Recession. The results show that, conditional on plant characteristics, there has been an exogenous decrease in the probability of closure since the Great Recession. Moreover, there is evidence for some sectors, particularly in services, that the negative relationship between TFP and closure that prevailed prior to 2008, was offset, or even entirely reversed after this date. This suggests that changes in the determinants of closure have indeed played a role in the UK's productivity puzzle.

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³ We thank an anonymous referee for drawing our attention to this. The results are provided in Tables U.6 and U.7 of the online appendix.

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